PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in and relating to the Suspension of Vehicle Wheels

I, FRIEDRICH EUGEN MAIER, of 30, Sommeringstrasse, Berlin - Charlottenburg, Germany, a German Citizen, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an arrangement for individually supporting the road wheels of automobiles and the like, of the kind in which a member carrying the wheel axle is slidable in a substantially vertical direction with reference to a member carried by the vehicle frame. It is an object of the invention to provide a telescopic arrangement with the necessary constructional freedom both for the horizontal axle of the running wheel and for the vertical or approximately vertical play of a spring. Then the axle of the wheel can be freely connected to the drive on the inside and such a telescopic arrangement will be suitable for driving wheels which are not steered as well as for steering wheels whether driven or not.

According to the invention, an upper member carried by the vehicle frame is slidable within a lower hollow guide and the hollow guide is united with the hollow bush for the axle of the road wheel in such manner that the centre lines of the hollow guide and axle bush cross but extend past one another without intersecting. The hollow guide and the axle bush are either made integral with each other or welded together. The approximately vertical guiding tube penetrates into the horizontal axle bush and leaves such a free space therein that the axle can still be introduced. One advantage of the arrangement according to the invention is that it makes it possible to reduce the total height of the vehicle.

A further advantage of the invention is that there is one slide only which is arranged close to or even below the wheel axle and thus reduces the pressure acting upon the slide; the interior bored surface of the vertical guide tube can be directly used as a slide so that a structural member is saved.

Another object of the invention is to design the vertical guide tube as a pot-like cylinder closed at its bottom so as to permit the insertion of a shock absorber. In this case the guide tube at the same time represents the cylinder of the shock absorber while the guiding member fastened to the frame of the vehicle is the piston of that shock absorber. The same means thus serve two different operative purposes.

A further improvement according to the invention consists in a circulatory lubrication accomplished by the two guiding members which are displaced relatively to each other each time the spring yields.

Further the transmission of the rotary steering movement from the stationary frame member to the tubular guide moving up and down is facilitated by that in the vertical pot-like cylinder there is inserted a second vertical guide tube the outside surface of which is the guiding slide surface. A guiding cylinder fastened to the frame of the vehicle can slide over this guide tube. In this way the assembling of the frame of the vehicle and the guiding cylinder is facilitated and the telescopic tubular guide is given a closed and dust-proof character.

Further features of the invention are disclosed in the following description with reference to the accompanying drawings which show several embodiments of the invention.

Wherever in the description and in the claims there is used the term vertical or practically vertical it is not to be understood in its strict geometrical meaning but as defining a direction which may be at a small angle to the true vertical.

In the drawings:

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Fig. 1 is a diagrammatic elevation and Fig. 2 a front view, partially in section.

Fig. 3 is a diagrammatic view showing the relative positions of the axle and the telescopic tubular guide.

Fig. 4 shows a telescopic tubular guide, partially in section, on a larger scale.

Fig. 5 is a vertical sectional view of another embodiment of the telescopic tubular guide.

Fig. 6 is another view in part section of the bottom portion of Fig. 5.

The running wheel 1 shown in elevation in Fig. 1 and in section in Fig. 2 is supported in the usual manner by an axle bush 2, the axle 3 and the bearings in which the axle revolves. The axle bush 2 is rigidly fastened to a practically vertical pot-like cylinder 4. Within the cylinder 4 there slides like a piston a tube 5 connected to the frame 6 of the vehicle in such a way that it is allowed to turn in a guiding cylinder 7 but is prevented from moving longitudinally therein. The vehicle proper yieldingly reposes on a coil spring 8. As is obvious from Figs. 1 and 2, the centre line 10 of the running wheel guide, which is identical with the centre line of the coil spring 8, passes laterally by the axle 3 of the wheel, and on account of its inclination it intersects the road surface 9 approximately at the point where the running wheel contacts with and is supported by the road. As seen from the front, the centre line 10 extends slightly outwardly and, as seen from the side, it extends slightly forwardly. The projection of this centre line 10 on the road 9 thus forms an angle both with the running direction 11 of the car and with the transverse axis 3*a* of the vehicle as shown in Fig. 3. The thick lines 10*a* approximately correspond to the plan views of the spring mounted tubular guides 4, 5, 8 while 12 and 13 signify the plan views of two running wheels of the vehicle.

The wheel 1 is steered by means of a steering linkage 14 connected to the tube 5. The steering efforts are transmitted to the vertical pot cylinder 4 as the latter is prevented from turning relatively to the tube 5. The said tube 5 is capable of displacement in but it cannot revolve in the pot cylinder 4.

The guide cylinder 7 is rigidly connected to the vehicle by frame tubes 6 is used as a bearing for the tube 5 which is revolubly mounted in the said cylinder 7. To support the tube 5 and to prevent it from leaving the cylinder 7 when the vehicle is lifted, the tube 5 is provided with a flange 15 at its top end. To the bottom end of the tube 5 is attached a piston 16 having a bore 17 for the passage of the shock absorbing liquid 18. The tube 5 contains a coil spring 8 the top of which bears against the member 20 rigidly connected with tube 5. The connection between the member 20 and the tube 5 is preferably obtained by the pin 21, shown in section, of the knuckle or linkage 14, which pin is intended for transmitting the steering forces. A recess 22 in the guide cylinder 7 permits of the angular displacement of the said linkage 14 and the tube 5 respectively through an angle corresponding to the deviation required, viz: about 60 degrees. The spring 8 rests at its lower end on a slide block 24 rigidly connected with the pot cylinder 4 by the bolt 23 and sliding in slots 25 in the tube 5. The length of the said slots corresponds to the play of the spring 8. The tube 5 is guided in the pot cylinder 4 on the one hand by the piston 16 and on the other hand by an annular sleeve 26 which, like the piston 16, is made of bronze. This sleeve 26 is provided with a cup-shaped extension 27 intended for collecting the lubricating liquid, if any. The bottom end of the guide cylinder 7 is also provided with a bearing bush 28. In order to prevent the penetration of dust and the like, a leather bellows arrangement 29 may be provided as shown by dotted lines to provide a dust-proof closure for the bearing points of the members 26 and 28. The axle bush 2 of the running wheel 1, which bush is rigidly connected to the pot cylinder 4, is not shown in Fig. 4 in order to avoid confusing the drawing.

In order that the shock absorbing effect of the liquid 18 can be adjusted, the bore 17 of the piston 16 may be adjustable. To the same end there may also be provided a tapered pin 30 extending into the bore 17 and fastened to the bottom cap 40. According to the space between the latter and the said piston 16 the free passage in the bore 17 is larger or smaller. The movement of the piston 16 may also be utilised for a lubrication both of the telescopic tubular guide and of other mechanical members arranged on the vehicle.

The steering forces to be transmitted to the wheel 1 are first transmitted through the linkage or knuckle 14 to the rotatable tube 5 and from the latter through the slots 25 to the slide block 24 rigidly connected to the pot cylinder 4. The axle bush 2 is rigidly connected to the pot cylinder 4, so that the wheel 1 is steered. The slide block 24 on which the coil spring 8 rests thus serves at the same time for transmitting the steering

forces. When the guiding appliance above described is to be used for running wheels which are not to be steered, it will be apparent that the tube 5 need not be revolubly mounted on the vehicle proper but can be rigidly connected with the latter. In this instance the slide block 24 would serve merely for preventing an angular displacement of the tube 5 relatively to the pot cylinder 4.

As shown in Figs. 1 and 2 a brake drum 33 may be connected with the running wheel 1. Instead of being outside the tubular guide, the brake drum 33 could be disposed on the other side of the tubular guide i.e., between the frame of the vehicle and the said telescopic tubular guide. When the wheel 1 is to be a driven wheel the axle 3 may be connected with the driving shaft at 34 (Fig. 2). This drive must, of course, be of some flexible type as the running wheel 1 continuously moves up and down. The coil spring 8 may also be replaced with other means, such as rubber, compressed air or the like. As shown by dotted lines in Fig. 2 the telescopic tubular guide may also be fastened to the frame of the vehicle by means of ball joints 35 at the top and bottom ends of tube 5. For this purpose the tube 5 extends through the pot cylinder 4 and the frame of the vehicle is also provided with a carrying rod 6, at the lower end of the telescopic tubular guide.

In the embodiment shown in Figs. 5 and 6, a guide tube 37 which is rigidly connected with the bottom portion of the pot cylinder 4 is inserted in the pot cylinder 4. The rigid connection consists of a detachable clamping connection 38, 39 which readily permits inspection or disassembling. The thickened portion 38 is serrated as is its counter-part so that an angular displacement of the said two members relatively to each other is prevented. The closing cap 40 may be used as a key or clamping member. It is however also possible to make the pot cylinder 4 integral with or to weld it to the guide tube 37. As seen most clearly from Fig. 6 the wall of the substantially vertical cylinder 4 penetrates into the axle bush 2 to such an extent that it approaches close to the wheel axle 3. The bearings 36 in which the axle 3 rotates are accommodated in the axle bush 2 in front of and behind the penetration (Figs. 2 and 6).

The guide tube 37 is guided in the guide cylinder 7 which is connected to the frame of the vehicle by an auxiliary sleeve 43. This guide sleeve 43 is connected with the guide cylinder by a clamping connection consisting of the seating 44 and the screw thread 45. Th said sleeve 43 carries the boss 41 which can be connected to the tube 6 of the frame of the vehicle by a threaded joint 42. This joint 42 is provided with a serration 46 in order that the torque, which develops particularly on braking. is safely transmitted to the frame of the vehicle. Moreover this serration affords a means for accurately adjusting the angle of inclination of the whole tubular guide relatively to the vertical in the running direction of the vehicle. Such an adjustability is also very important for the inclination of the telescopic tubular guide in two directions as above described. Moreover this threaded joint 42 combined with its serration 46 enables the running wheel together with the telescopic tubular guide to be removed readily and quickly. The said clamping joint 44, 45 at the auxiliary sleeve 43 facilitates assembling as over the whole length of the sleeve 43 there remains a free space between the latter and the inner guide cylinder so that uneven spots such as may arise on the inside surface of the sleeve 43 by welding the boss 41 to it or by pressing or rolling the sleeve, are not detrimental.

Also the embodiment according to Fig. 5 is intended for a steered wheel. Therefore the top end of the guide cylinder 7 is provided with a thrust bearing acting both downwards and upwards and which comprises the member 15 of the guide cylinder 7 and the revoluble bush 47 with the washer 48. The coil spring 8 bears with its top end against the said bush 47. The lower end of the coil spring 8 bears by way of a washer 49 against an internal flange 50 in the guide tube 37.

For steering there is provided a steering knuckle pivot the design of which approximately corresponds to that of the tube 5 in the embodiment according to Fig. 4. The top end of this steering pivot tube 5 is rigidly connected with the thrust bearing 15 and the knuckle 14 by the screw 51. The knuckle 14 is prevented from turning on the steering tube 5 by a plurality of flutes. The further transmission of the angular displacement from the steering tube 5 to the guide tube 37 for steering purposes is effected as follows: Adjacent its lower end, the steering tube 5 is provided with fine serrations upon which an annular piston 16 provided with corresponding internal serrations is positioned and secured in this position by a threaded plug 52. On its outer cylindrical surface the annular piston 16 is provided with coarse serrations which are in engagement with corresponding serrations in the inside

wall of the guide tube 37. Therefore on account of the outside serrations on the piston 16, the tube 5 cannot be turned relatively to the guide tube 37 but it is free to move longitudinally relatively thereto. As the guide tube 37 is rigidly connected to the pot cylinder 4 and the latter to the axle bush 2, any angular displacement of the knuckle 14 will therefore be transmitted through the tube 5 with its piston 16 to the guide tube 37, the pot cylinder 4 and the axle bush 2 and thus to the axle 3 of the running wheel 1. The pitches of the serrations at the top and bottom ends of the steering pivot tube may be different so that by turning of one member through one tooth of the serration a vernier effect is obtained inasmuch as the different pitch of the serration at the other end results in an angular displacement through an angle which is much smaller than the pitch of one tooth of the serration. This vernier effect may also be extended to the serration on the outside surface of the annular piston 16, in addition to that obtained by the two serrations at the upper and lower ends of the steering pivot tube 5.

With the aid of the annular piston 16 and the threaded stopper 52 a hydraulic shock absorber can also be provided in this embodiment of the invention. An efficient feature in this embodiment is that the serrations disposed on the outside surface of the annular piston 16 for transmitting the torque from the pivot tube 5 to the guide tube 37 are continually bathed by the oil which is used as the shock absorbing liquid and is forced through the serrations. As the serrations used as a means for transmitting the torque represent a large surface, such an automatic forced lubrication with continuous passage of the lubricating oil is particularly efficaceous.

Rubber buffers are arranged at either end of the travel of the shock absorber piston 16, 52 namely the rubber stopper 53 on the closure cap 40 at the bottom and at the top three rubber rings 54 between the washers 55 and 56. These washers are introduced in a vertical plane through two recesses in opposite positions in the serrations of the guide tube 37 and are subsequently tilted into their horizontal positions so as to bear against the internal flange 50 and the front end of the internal serrations in the guide tube 37 respectively.

The design of the telescopic tubular guide as described above makes it possible to provide an automatic circulation of lubricant under pressure with the aid of the members already provided for the tubular guide proper. For this purpose it is only necessary to provide a check valve 57 in the threaded stopper 52 and a thin pipe 58 communicating with the passage 17 and extending from the piston 16 upwards as far as the thrust bearing 15. The cross-sections of the pipe 58 and associated check valve 57 are adapted to the desired shock absorbing effect. A cup-like shell enclosing the pipe 58 at 59 encloses a greasing chamber between itself and the upper thrust bearing 15. At each compression of the telescopic tubular guide a portion of the lubricant present below the piston 16 will be pressed upwards and kept back by the check valve. This lubricant is continuously delivered through the oil grooves 60 to the thrust bearing 15. 47, 48 and after having passed through the same it flows again downwards along the internal wall of the guide cylinder 7. This results at the same time in a continuous lubrication of the inner slide surface of the guide cylinder 7 and the outside slide surface of the guide tube 37. This effect can be increased by utilising the vacuum developing under the shock absorber piston 16, 52 when the telescope spring is released. A check valve or a plurality of check valves 61 disposed at the bottom end of the pot cylinder 4 serve for connecting the annular space between the guide tube 37 and the pot cylinder 4, with the space below the shock absorber piston 16, 52 when the piston is moving upwards, but close as soon as the piston 16, 52 begins to descend. A bellows arrangement 29 between the top of the pot cylinder and the guide cylinder 7 serves to prevent leakage and the ingress of dust. In this way the slide surface of the telescopic tubular guide which is exposed when the members thereof are displaced relatively to each other, namely the outside surface of the lower guide tube 37, is also enclosed. The check valves 61 in the cylinder of the shock absorber and the check valve 57 in the piston of the shock absorber result in an increased pressure of the oil at the thrust bearing 15 and in a suction by vacuum at the outside sliding surface of the guide tube 37 within the bellows 29. Consequently there is established a continuous, automatic circulation of the shock absorber liquid which is used as a lubricant.

When the running wheel 1 is to be used without a steering device in combination with the telescopic tubular guide the upper thrust bearing 15 is replaced by a rigid connection. The steering pivot tube 5 can then be omitted or can be used as a guide for the coil spring 8 by being rigidly connected to the

member 15, the members 47, 48 and 60 being omitted. In this design the telescopic tubular guide may also be used as a so-called spring leg for aeroplanes.

If desired, a common wheel guide can be provided for two wheels. In this case the wheel guide is arranged between the two wheels and is associated with a common bush for the two axles. the axis of the guide tube passing to one side of the common axis or axial connecting line of the two running wheels.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An arrangement for resiliently mounting a road wheel on a vehicle, more particularly a motor vehicle, in which an upper member carried by the vehicle frame is slidable with respect to a lower hollow guide and the hollow guide is united with the hollow bush for the axle of the road wheel in such manner that the centre lines of the hollow guide and axle bush cross but extend past one another without intersecting.

2. An arrangement as claimed in claim 1 in which the steering movement for the road wheel is imparted to the upper member and is transmitted to the lower hollow guide by means of a connection permitting relative sliding movement between upper member and hollow guide but preventing relative rotation.

3. An arrangement according to claim 1 or 2 in which the hollow guide is constituted by a pot-like cylinder which is open on top and closed at the bottom and is attached to the horizontal axle bush in a substantially vertical position.

4. An arrangement according to claim 1 or 2, in which a substantially vertical cylinder crossing the horizontal axle bush close to the wheel axle carries a guide tube which is concentric with and extends above said cylinder and a guide cylinder mounted on the vehicle engages the said guide tube from above and is adapted to slide down as far as the bottom of the cylinder.

5. An arrangement according to claim 3 or 4, in which the substantially vertical cylinder penetrates into the horizontal axle bush so far that the wall of the cylinder approaches close to the wheel axle in the axle bush, the axle bearings of the requisite size being accommodated in front of or behind the penetration.

6. An arrangement according to claim 3 in which the two members arranged transversely to each other, viz. the horizontal axle bush and the substantially vertical pot-like cylinder constitutes an integral structural member.

7. An arrangement according to claim 3, 4, 5 r 6 in which the centre line of the substantially vertical pot-like cylinder is so inclined both in the running direction and transversely thereto that its prolongation intersects the road approximately at the point of contact of the wheel.

8. An arrangement as claimed in any of the preceding claims 3 to 7, in which the substantially vertical pot-like cylinder and a cylinder fastened to the frame of the vehicle and closed on top are constructionally so connected with each other that the guide tube limits the axial longitudinal movement, serves as a knuckle pivot for the steering wheels, accommodates a built in shock absorber and can be assembled or dismantled without the necessity of dismounting the wheel.

9. An arrangement according to any of claims 3 to 8 characterised by the provision in the lower pot cylinder of a hydraulic shock absorber which is formed by a hollow piston rod represented by the guide tube which is at the same time adapted to transmit the steering movement, the rotary steering movement being transmitted by way of guide slots and a cross pin engaging therein to the pot cylinder carrying this cross pin, and consequently to the running wheel.

10. An arrangement according to claim 8 or 9 in which the pressures arising by the counter-movement of the movable members are utilised to create a pump effect for lubricating purposes.

11. An arrangement according to claim 10, in which the shock absorbing liquid is utilised for the lubrication.

12. An arrangement according to claim 10 or 11, characterised by an automatic circulatory system lubrication of the upper thrust bearing of the tube and the upper wheel guide a stationary pierced piston with an upwardly extending pipe opening at the top end of the guide tube while being disposed in the oil bath of the lower pot cylinder while the lubricating oil leaving the thrust bearing or the upper tubular guide flows back into the oil bath in the lower pot cylinder.

13. An arrangement according to claim 12, in which the hollow piston rod is directly used for conveying the lubricant.

14. An arrangement as claimed in any of the preceding claims, comprising running wheels on both sides of the hollow guide.

15. An arrangement according to claim 9, in which a coil spring disposed between the upper stationary member and the lower revoluble and longitudinally dis-

placeable member bears at its ends against members which extend across the tubular guide.

16. An arrangement according to claim 1, in which the tubular guide is supported at its top and bottom ends on the frame of the vehicle preferably by means of ball joints.

17. An arrangement according to claims 1 and 8 in which the cylinder closed at the top and attached to the frame of the vehicle is connected with the lower pot cylinder by a bellows arrangement which is applied to the two open ends of these cylinders.

18. An arrangement according to claims 1, 3 and 4, characterised by a detachable clamping joint connecting the guide cylinder to a structural vehicle member extending transversely relatively to it, an auxiliary sleeve being connected with the member or directly with the frame of the vehicle by being made integral with or welded to the same. the members of the clamping joint being arranged in such a way that a clearance is left between the inside of the sleeve and the outside surface of the guide cylinder.

19. An arrangement according to claim 18, in which the guide cylinder and the auxiliary connecting sleeve respectively are connected with the structural member of the frame by a screw joint provided with a serration on each seating surface.

20. An arrangement according to claims 1, 3 and 4, in which the steering knuckle pivot extends concentrically from the top opening of the guide cylinder and the upper thrust bearing is revoluble but not longitudinally displaceable in the said thrust bearing.

21. An arrangement according to claims 1, 3 4 and 20 in which the longitudinally displaceable but not revoluble coupling between the knuckle pivot lodged in the upper guide cylinder and the lower guide tube is effected by serrations the external teeth of which are in the knuckle pivot and the internal teeth in the guide tube.

22. An arrangement according to claims 1, 3, 4, 20 and 21, in which the knuckle is firmly attached with its connecting boss to the end of the knuckle pivot extending from the guide cylinder by means of serrations similar to those provided at the lower end of the knuckle pivot for the longitudinally displaceable connection with the lower guide tube, the number of teeth at the lower knuckle pivot end being however preferably smaller by one tooth than that of the serrations at the top end of the knuckle pivot.

23. An arrangement according to any of claims 20 to 22, in which the hollow knuckle pivot closed at its bottom end is utilised as a shock absorber by the space between the outside serrations on the lower knuckle pivot end and the inside serrations in the guide tube being dimensioned so as to produce the necessary resistance to the flow of the lubricating oil serving as shock absorber liquid so that the lubricating oil continually passes between the tooth surfaces particularly during their relative longitudinal displacement.

24. An arrangement according to claim 23, in which the annular space formed between the pot cylinder and the guide tube inserted therein is used for collecting the oil leaving the slide surface between the guide tube and the guide cylinder.

25. An arrangement according to claim 23 or 24. in which a check valve which opens during the upward stroke and closes during the downward stroke of the lower guide tube is disposed in the bottom of the knuckle pivot and the shock absorber piston.

26. An arrangement according to claim 24 or an arrangement according to claims 24 and 25, in which the oil collecting annular space in the pot cylinder is connected in fluid-tight manner with the stationary guide cylinder by a sleeve adapted for longitudinal and angular displacement and check valves which when a vacuum prevails in the shock absorber cylinder open into the latter so as to discharge thereto the oil collected, are provided at the bottom of the oil collecting annular space.

27. An arrangement according to claim 25 or to claims 24, 25 and 26, in which the cross sections of the lubricating pipe leading to the upper thrust bearing and of the check valve inserted therein are adapted to the desired shock absorbing effect.

28. An arrangement according to claims 1, 3 and 4 characterised by an internal flange within the guide tube against which flange the coil spring bears from above while the structural members, e.g. shock absorber, knuckle pivot, rubber buffer and washers inserted from below beneath the internal flange, are limited in their upward movement by the said internal flange.

29. An arrangement according to claims 1, 3 and 4, in which the connection of the guide tube with the bottom end of the pot cylinder is effected by a detachable clamping joint.

30. Independent suspensions for vehicle wheels constructed and arranged substantially as described with reference

to and as shown in the accompanying drawings.

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Agents for the Applicant.

Dated this 28th day of November. 1935.

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Fig. 1

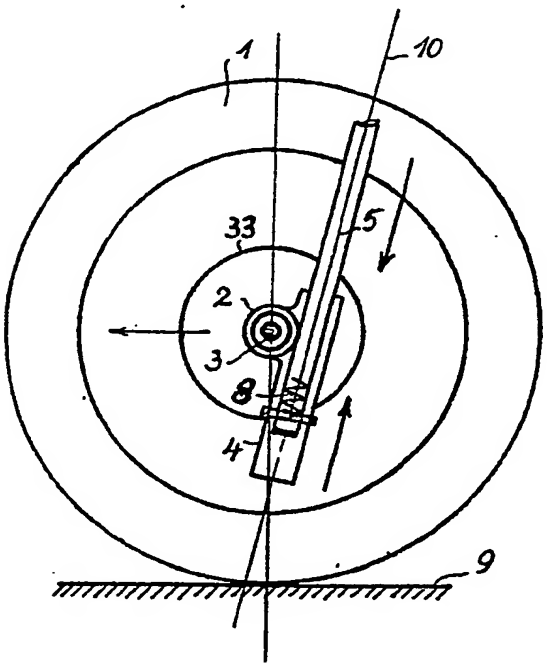
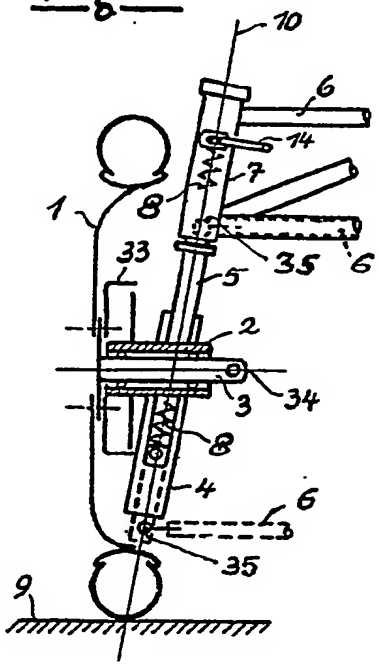


Fig. 2



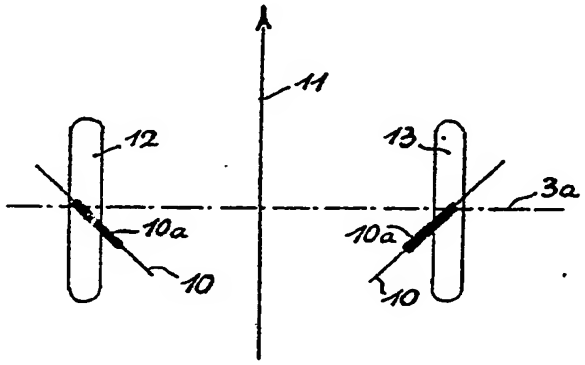


Fig. 3

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Fig. 4

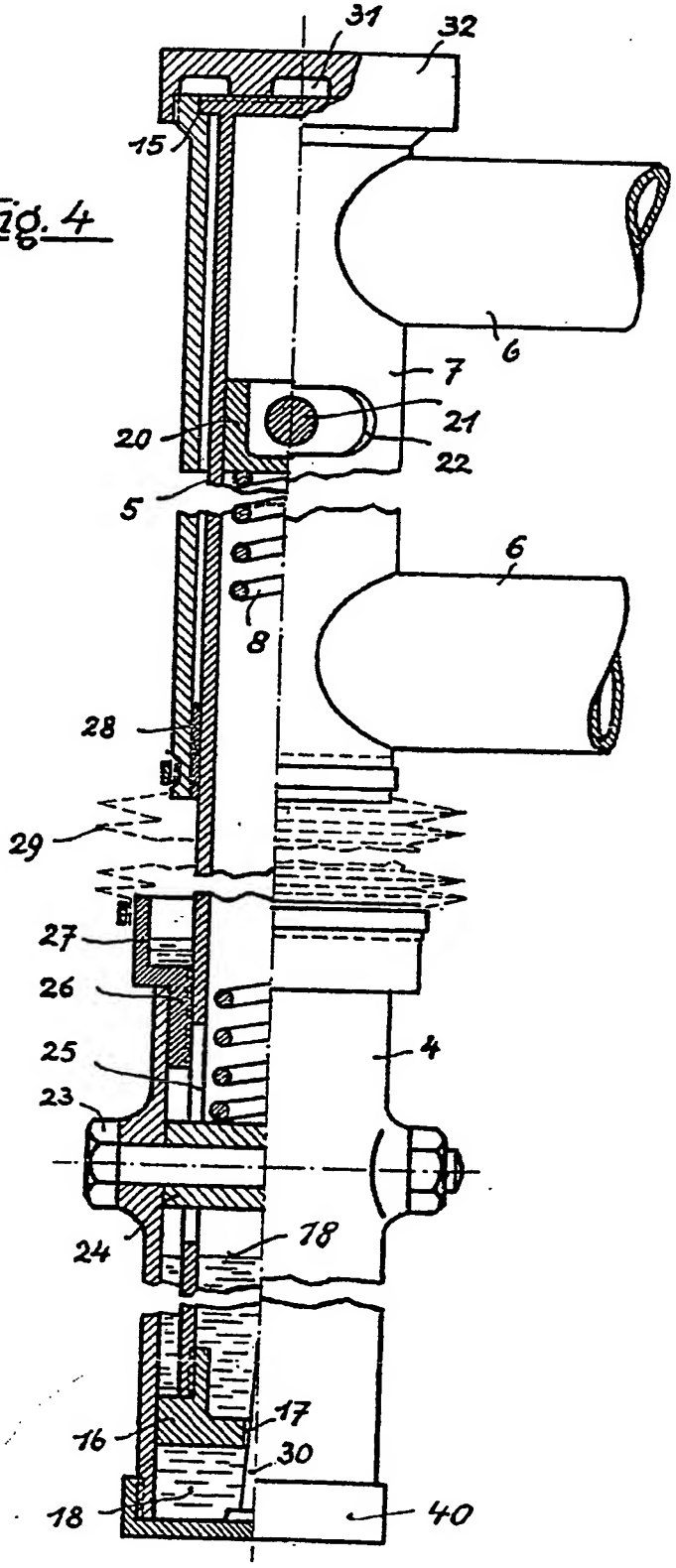

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Fig. 1

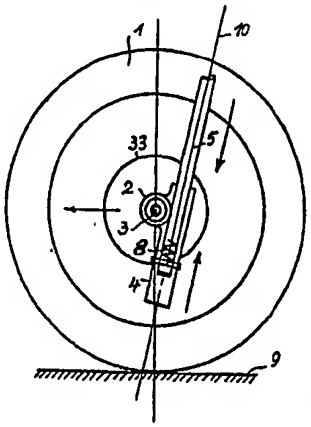
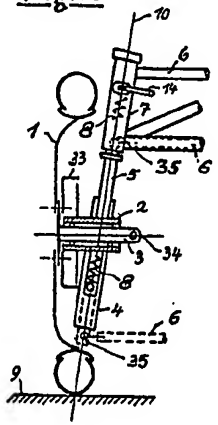


Fig. 2



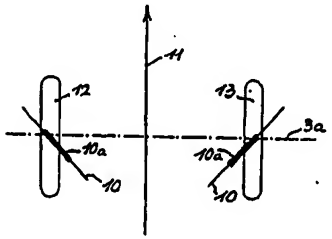
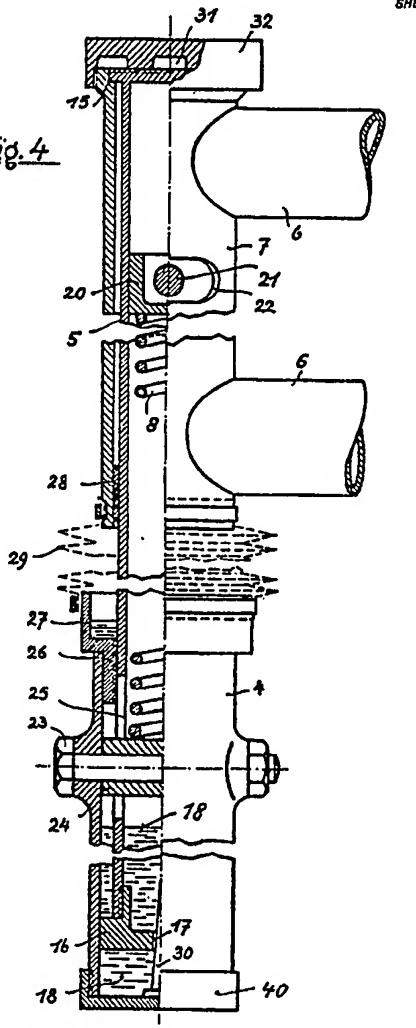


Fig. 3

Fig. 4



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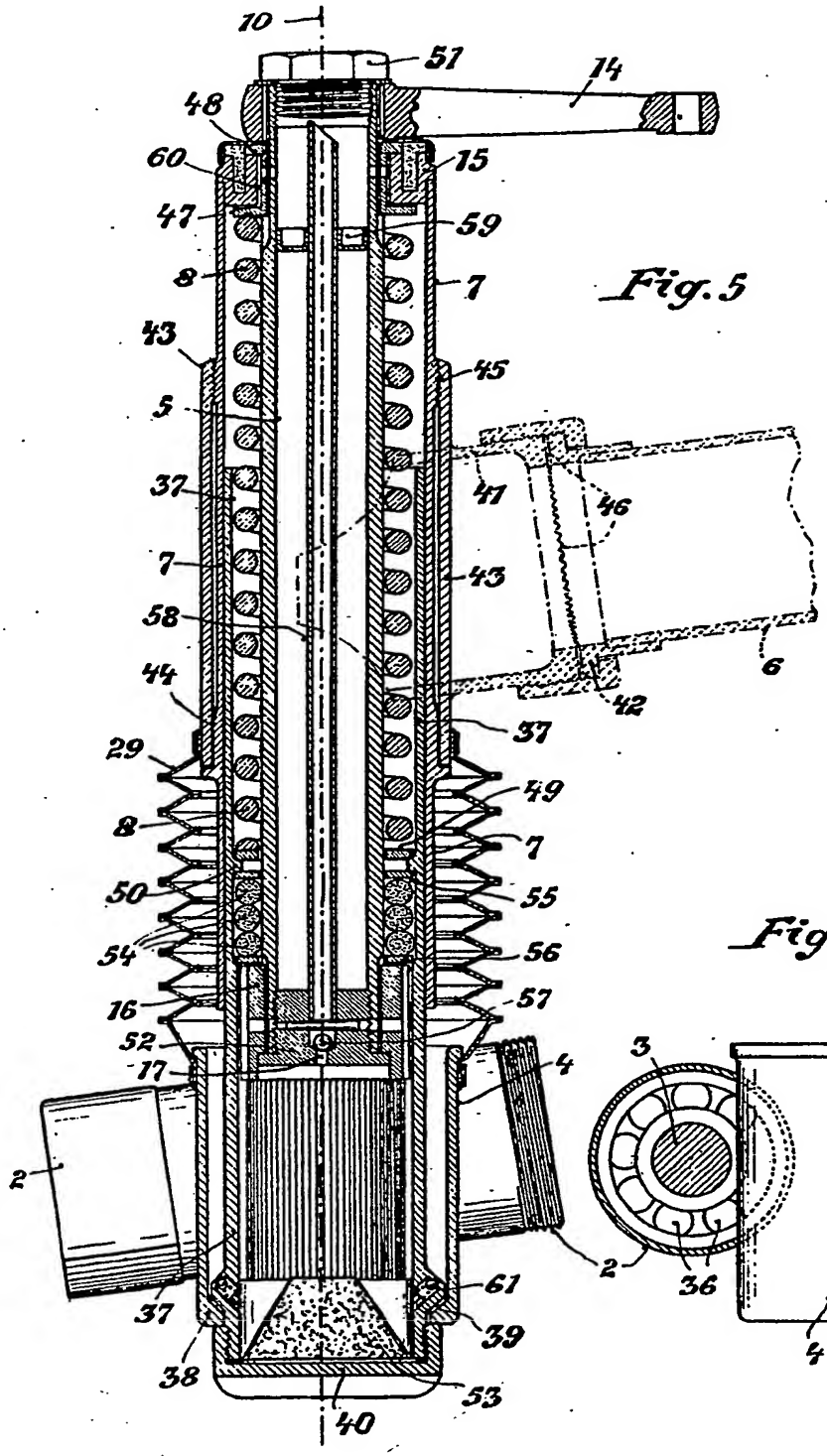

Fig. 5

Fig. 6

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Fig. 1

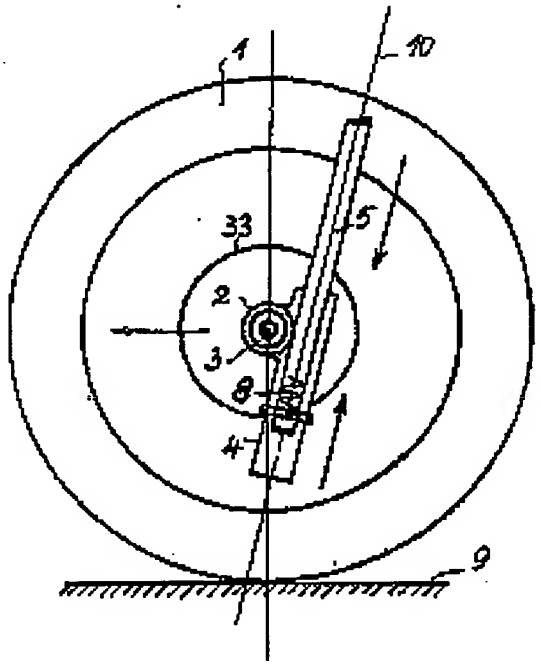
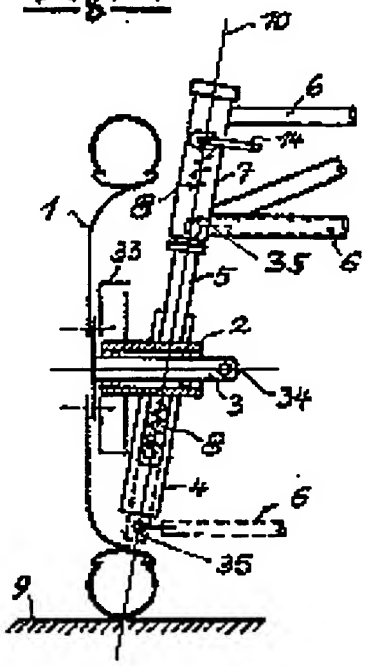


Fig. 2



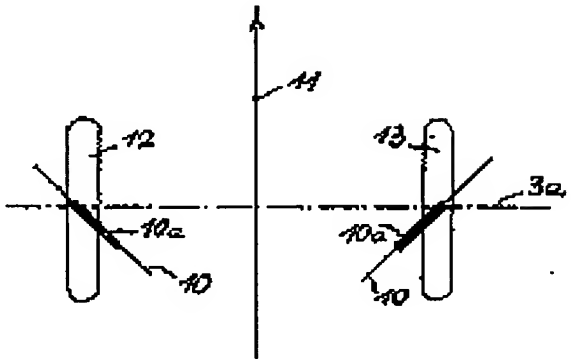


Fig. 3

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Fig. 4

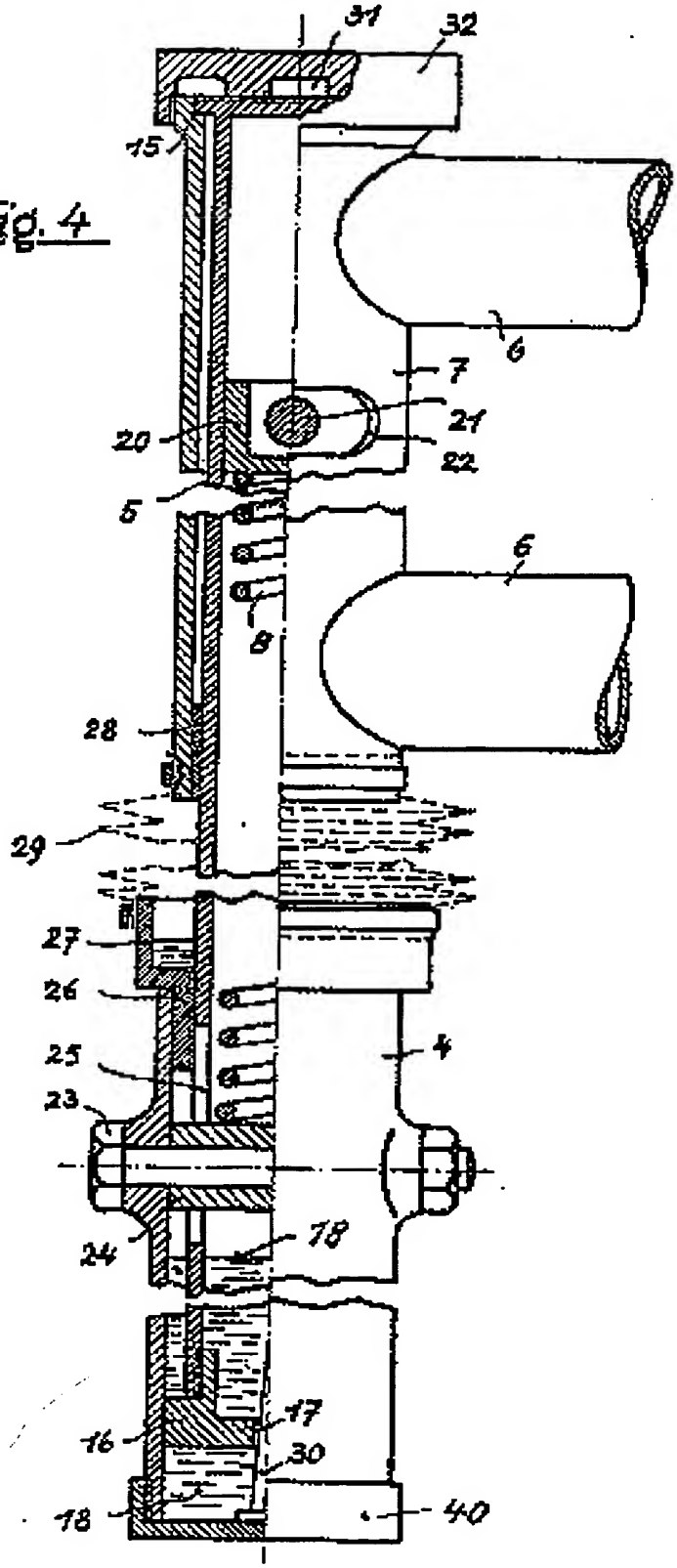

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Fig. 1

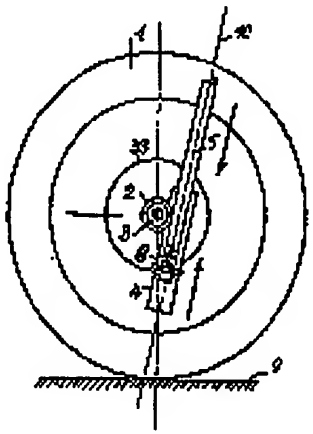


Fig. 2

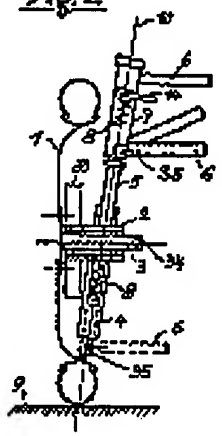


Fig. 3

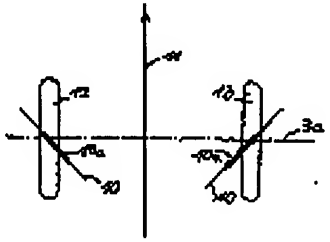
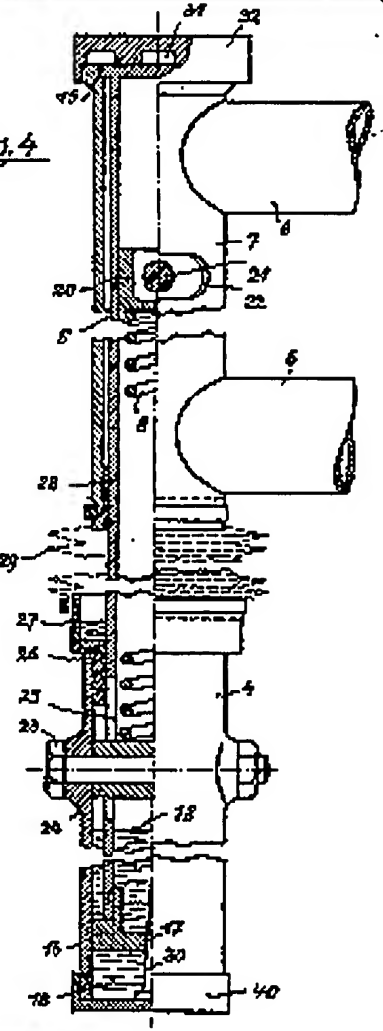


Fig. 4



[This Drawing is a reproduction of the Original on a reduced scale.]

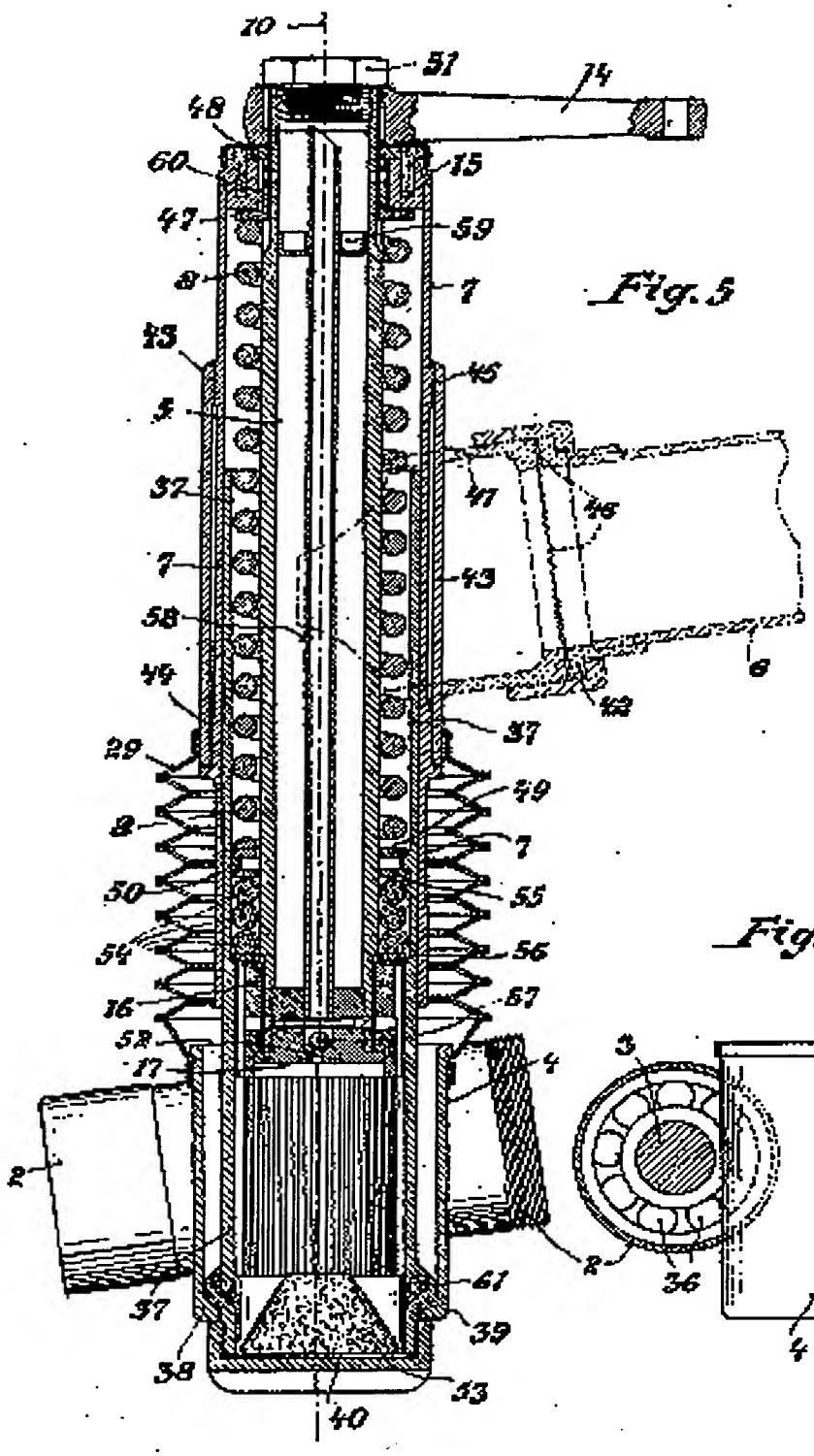


Fig. 5

Fig. 6

Malby & Sons, Photo-Lith.